Physics Analysis Meeting

Kétévi A. Assamagan

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Physics Analysis Meeting
Update on Charged Higgs Studies

- **b-tagging by jet charge method**
- **NN study with ATLAST**
- **Geant3 study with NN or using b-tagging by jet charge method**
- **The plan**

Signal Combinatorial Ambiguity

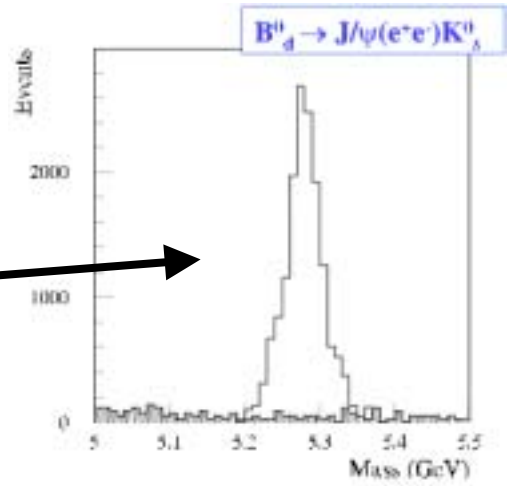
- $g\bar{b} \rightarrow tH^-$
  - $H^- \rightarrow \bar{t}b$
  - $t \rightarrow W^+b$
  - $\bar{t} \rightarrow W^-\bar{b}$
- After the reconstruction of the 2 top quarks, the remaining b-jet can be paired with either top quark to give 2 charged Higgs candidates : one of these is the wrong candidate giving a combinatorial background
- But the ambiguity is removed if we know the charge signs of the b quarks at production, similar to the situation of CP violation in the B-system

CP violation in B-system

SM prediction of CP-violation A(t) in $B^0_d \to J/\psi K_s^0$:

$$A(t) = \sin 2\beta \sin(\Delta m_d t)$$

$B^0_d \to J/\psi\,(\to l^+l^-)\; K_s(\to \pi^+\pi^-)$



- CP violations studies need determination of B flavor at creation time; in ATLAS used:
  - opposite side lepton
  - B-π correlation
  - "jet charge" tag

σ_m = 22 MeV

σ_R = 64 μm

- Most effective flavor tag performance:
  - $J/\psi \to e^+e^-$ (lepton tag):
    100% efficiency relative to triggered event, 22% mistag probability
  - $J/\psi \to \mu^+\mu^-$ (B–π tag):
    82% efficiency relative to triggered event, 42% mistag probability
- For asymmetry studies after 1 year of low luminosity (10 fb-1):

	$J/\psi \to \mu^+\mu^-$	$J/\psi \to e^+e^-$
$N(B^0 \to J/\psi K^0_s)$	160 000 S/B ~ 30	4 800 S/B ~ 15
δ(sin2β)	0.022	0.031

Uncertainty will be dominated statistics. Systematics from false asymmetries will be measured using channels with 0 CP-asymmetry:

$B^+ \to J/\psi K^+$

Combined δ(sin2β) at 10 fb^{-1} 0.017 (statistical) : comparable to LHCb

Flavor Tagging by "jet charge"

- **Use the net charge of the tracks produced near the B meson. This charge is correlated to the flavor of the B meson. Must select tracks likely to belong to b quark fragmentation**

$$Q_{jet} = \frac{\sum_{i=1}^{n} q_i w_i}{\sum_{i=1}^{n} w_i}$$

- **Re-definition of a b-jet: search for a B-meson in the event and define the b-jet as all the particles in ΔR of the B-track, excluding the B meson**
- **The 3 tag flavor tagging techniques have being studied for ATLAS: methods optimized by maximizing the quality factor $Q = \varepsilon D^2$ (statistical methods). But now, we want to use the B-π correlation or the jet charge on event by event basis and cross check with the standard b-tagging technique.**

The Plan

- **Study the signal in ATLFAST to see if a likelihood or NN method can be used to remove the combinatorial ambiguity. This study will start soon, slowly.**
- **Go to full simulation. If the NN analysis does not bring any significant improvement, study the flavor tagging by "jet charge" as a way to resolve the combinatorial problem. 2000 full simulated events are being produced by Alex as a test. Full production of 2x105 events (signal + ttbar) starts afterwards.**

Conclusions

- **Study $H^{\pm} \rightarrow tb$ and see if a likelihood or NN analysis can improve the signal selection over the signal combinatorial. This will be done at ATLFAST level.**
- **If no improvement is expected, a b-tagging by jet charge technique will be investigated as a way to determine the charge signs of the b-quarks at production : this will resolve the combinatorial ambiguity.**